Buck Scientific VIS 100 Operation Manual

Safety

This is important information; please read carefully before installing or using this instrument.

1. The Vis 100 spectrophotometer is designed for operation by **trained personnel** that are aware of the principles and applications involved. For further help and advice please cont act us e-mail sales@bucksci.com or visit www.bucksci.com

2. The Vis 100 spectrophotometer is a sensitive electronic and optical instrument designed for use in a laboratory environment. Careful adherence to the inst allation instructions must be observed. If in doubt contact a **relevant and competent authority** for advice before proceeding.

3. In addition to observing the instructions det ailed in the Operating Manual and Service Manual for this instrument all installation, operating and service personnel must be aware of, and employ , **a safe system of work**.

4. Voltage levels hazardous to life are present in this instrument, for personal safety only **trained engineers** aware of the risk and avoidance of electric shock should remove protective covers from the instrument.

5. This instrument is designed for minimal maintenance, which must be carried out carefully following the **procedures detailed in this manual**. All safety instructions in these procedures as well as those defined locally for the **area or environment** where the work is being carried out must be observed.

6. Other than for those items defined in the maintenance procedures herein there are **no user serviceable** items in this instrument. Removal of covers and attempted adjustment or service by unqualified personnel will invalidate any warranty and incur additional charges for rep air.

7. Reference should always be made to the **Health and Safety Data** for any chemicals or reagents used. All available information, advice and warnings on the handling, storage, use and disposal of such must be carefully observed. When not available this dat a must be requested from the supplier before proceeding in any way.

8. It is important that **good laboratory practice** is observed when handling samples, chemicals, reagents and ancillary equipment in order to carry out measurement and analysis with this instrument. Suitable **safety and personal protective equipment** must be used at all times.

9. If it is suspected that safety protection has been imp aired in any way, the spectrophotometer must be made inoperative and secured against any intended operation. The fault condition must be reported to the appropriate servicing authority. In all such report s model number and serial number of the spectrophotometer must be reported.

Vis 100 SPECTROPHOTOMETER
OPERATING MANUAL

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SECTION 1

INTRODUCTION

1.1 INSTRUMENT DESCRIPTION

The 100 is microprocessor controlled Visible Range Spectrophotometer covering the wavelength range of 320 to 1000nm with a 8nm bandwidth. The monochromator is of a modified Czerny Turner design, incorporating a stepper motor driven 1200 lines/mm holographic diffraction grating and featuring automatic second order response suppression. The 100 model has full interfacing capability for Analogue output and serial (RS232) interfacing. The optical system is independantly housed and isolated with lenses to give maximum protection from environmental contamination. Combined with a mechanically rigid structure, these models provide a system with fast warm-up, low drift and high reliability.

1.2 INSTRUMENT SPECIFICATIONS

Wavelength:	
Range	320 - 1000nm
Resolution	1nm
Accuracy	±2nm
Bandwidth	10nm
Transmittance:	
Range	0 to 199.9%
Resolution	0.1%
Stray Light	<0.5%
Photometric Accuracy	±2%
Absorbance:	
Range	-0.300 to 1.999A
Resolution	0.001A
Concentration:	
Range	-300 to 1999 Concentration
Resolution	0.1/1
Units	ppm, mg/l^{-1}, g/l^{-1}, M, blank
Factor	0 to 999.9, 1000 to 9999
Photometric Noise Levels:	<1%
Photometric Stability:	1%/Hr after warm-up
Readout:	Custom LCD Graphics display
Outputs:	Analogue (0 - 1.999V d.c.) / RS232 serial port
Light Source:	Tungsten Halogen 20W 12V
Input Voltage:	115/230Vac -20% + 10%
Input Power:	<50W
Size:	365 (w) x 272 (d) x 160 (h)mm
Weight:	6Kgs

SECTION 2

INSTALLATION

2.1 UNPACKING

Remove the Vis 100 from the packaging and ensure the following items are present:

1. Model Vis 100 Spectrophotometer
2. Mains Cable
3. Pack 100 disposable Cuvettes (060 084) -
4. Interface Cable (013 210)
5. 6$_3$-Zero Software (635 100)
6. Optional Accessories (as ordered)

Any shortages or damage should be reported immediately to the Manufacturer or your local Distributor.

2.2 INSTALLATION

MAINS SUPPLY

The vias 100 model is designed to operate on 115/230V a.c. supply (-20%+10%) 50/60Hz.
The standard 2 metre mains cable supplied with the unit is fitted with an IEC type connector which can be plugged directly into the POWER IN socket on the rear panel.
The mains fuse is housed within the POWER IN socket. When replacing the fuse the unit must be disconnected from the mains supply.
In the event of the fuse failing after replacement it is advisable to consult with the Manufacturer or your local Distributor before proceeding further.

Fuse Rating: 2A 'F' (fast blow type)
NOTE: The unit should be positioned within 1.5 metres of an earthed mains supply.

VOLTAGE SELECTION

NOTE: When changing the voltage select switch position always ensure the fuse rating is correct.

Before attempting to change the voltage select disconnect the instrument from the mains supply. Withdraw the fuse holder from the power input socket and remove the fuse. Extract the grey fuse retainer and rotate so that the correct voltage is visible through the aperture in the fuse holder. Replace the fuse retainer in its holder, fit the correct fuse and push assembly back into the power input socket.

MAINS CONNECTIONS

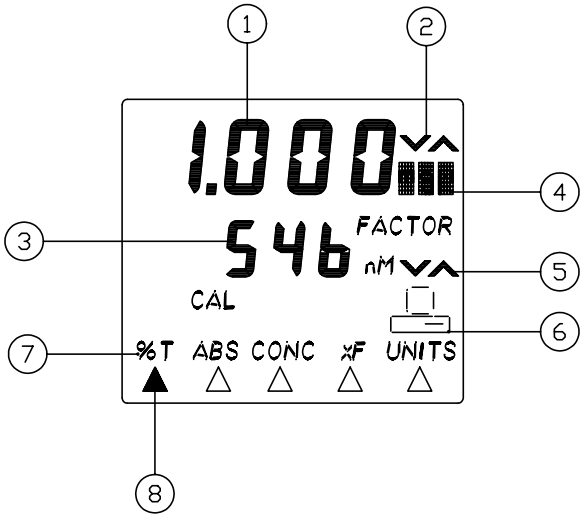
The unit is supplied with a moulded on plug. However, if this is removed for any reason the connection wires in the mains lead are colour coded to conform to the internationally recognised standard such that:

UK CONNECTIONS		US CONNECTIONS	
BROWN	**LIVE**	**BLACK**	**LIVE**
BLUE	**NEUTRAL**	**WHITE**	**NEUTRAL**
GREEN/YELLOW	**EARTH**	**GREEN**	**EARTH**

IMPORTANT: THE UNIT MUST BE EARTHED.

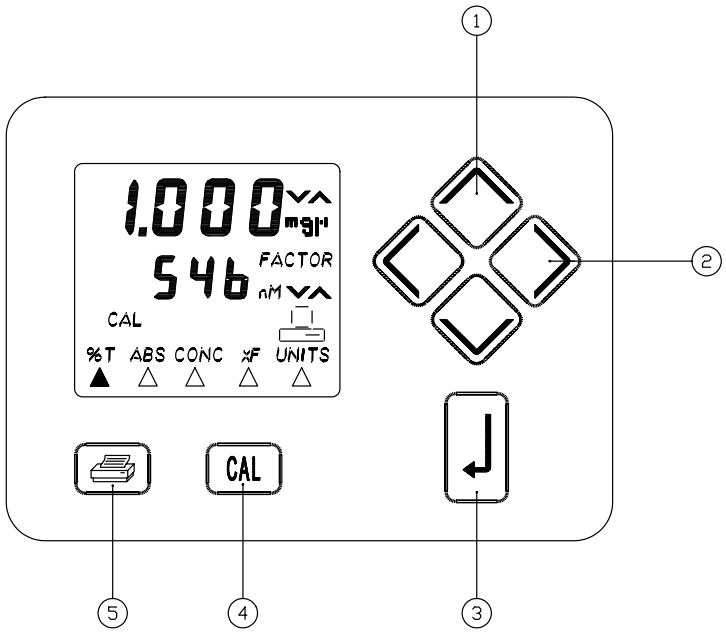
The Green/Yellow wire in the a.c. supply cable must be connected to a properly grounded terminal.

2.3 DISPLAYS



1. Primary display area - Transmission, Absorbance, Concentration
2. Primary display adjust annunciator
3. Secondary display area - Wavelength, Factor
4. Primary display units
5. Secondary display adjust annunciator
6. Operation with PC
7. Menu options - %T ABS CONC FACTOR UNITS
8. Menu pointers (for 7)

2.4 CONTROLS



1. used to adjust values on the selected display

2. used to move the cursor horizontally between menu options

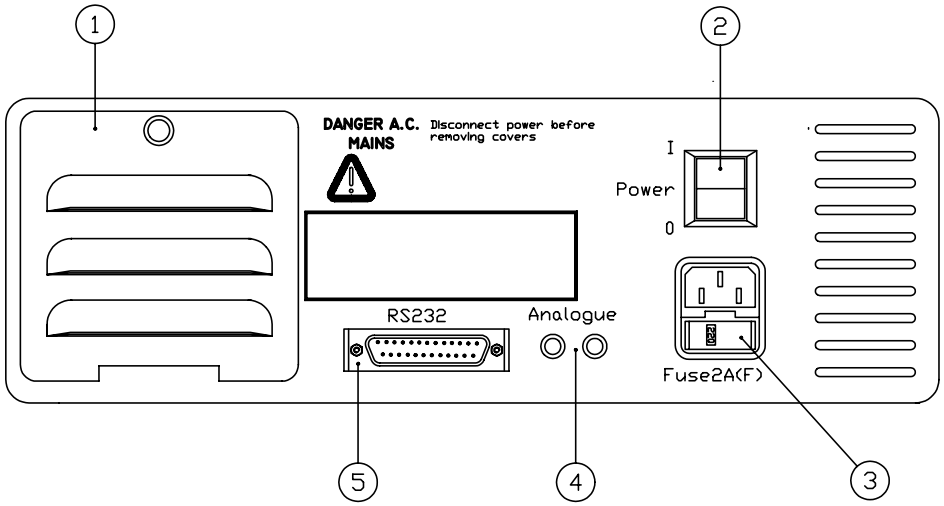
3. used to select the displayed menu option

4. initiates a calibration routine

5. Print key. Provides a printout of the current reading with an incremental sample number. When pressed for the first time after a calibration the print out will give calibration information. The incremental sample number will be reset after a calibration.

2.5 INPUTS/OUTPUTS

Fig. 2.5.1 Rear Panel Layout



1. **LAMP ACCESS PANEL**	This panel allows the user to gain access to the tungsten halogen lamp when replacement is necessary. **NOTE: The Lamp Access Panel and all ventilation slots must not be covered or obstructed at any time.**
2. **ROCKER SWITCH**	On/Off switch for the unit.
3. **POWER IN SOCKET**	IEC type connection socket for mains cable.
4. **OUTPUT SOCKETS**	Analogue output.
5. **OUTPUT SOCKET**	Output socket for (25 way) RS232.

2.6 SAMPLING

The Model VIS 100 is supplied with a 10mm cuvette holder. Other options can be fitted (refer to Section 5, Optional Accessories).

The Model VIS 100 has a dual 10mm cuvette holder with a 12.7mm test tube holder. The domed lid on this model enables tall test tubes (up to 100mm in height) to be used.

WARNING: The optical characteristics and light path of the cuvettes and test tubes used in the dual purpose sample holder vary so cannot be interchanged. Calibrate on one and use only the same type of sample holder for each analysis batch.

SECTION 3

OPERATION

3.1 INITIAL SET-UP

NOTE: If the unit is in continuous use it is recommended that it should be left switched on to obtain maximum lamp life. Do not open the sample chamber door during initialisation.

Connect the unit to the correct mains supply and switch on. After switch on, the Vis 100 automatically re-aligns the monochromator at zero order wavelength. During this initialisation, the instrument displays CAL on the primary display and the wavelength on the secondary display. The wavelength will change as the instrument searches for the peak output at zero nm. After calibration, the unit will then go to the last wavelength used and enter the measurement mode last used.
The following error conditions, which are displayed for 2 seconds, are possible if the instrument fails to find the zero order peak:

Err 4 Lamp failed after initially finding 0nm peak. If the lamp has failed, it should be replaced.

Err 5 No light level detected. The instrument has failed to find a zero order peak. Possible causes of this error are that the lamp has failed or that a sample has been left in the unit which is absorbing the zero order light.

Err 6 No dark level detected. The instrument checks the region below 320nm which should have no optical throughput. If this region cannot be found the most likely cause is that the sample chamber lid is not closed.

3.2 SAMPLE MEASUREMENT

Many methodologies are well documented and where these are available the recommended wavelength should be used. Where a new methodology is being developed, the choice of wavelength can often be approximately determined by choosing an absorbance wavelength that is complimentary in colour to that of the standard solution. The list given below illustrates this point. The chart may be read from left to right or right to left, i.e; a blue sample requires a yellow wavelength / a yellow sample requires a blue wavelength.

Blue	-	Yellow
Greenish/Blue	-	Orange
Bluish Green	-	Red
Green	-	Red or Blue

Colors, as they relate to wavelength, can be reviewed by placing a screen, i.e; a piece of card in the light path where it passes through the sample chamber. It will be seen that 400nm gives blue light and 700nm gives red, with a progression between these points of green, yellow and orange.

NOTE: The human eye is unable to detect wavelengths below 400nm or above 700nm.

Once a complimentary colour has been chosen the precise analytical wavelength needs to be selected. This wavelength will normally be that which gives the maximum absorbance value. This can be selected by scanning in 5nm steps until an optimum is reached. It should be noted that zero absorbance point will change with wavelength. A zero CAL should be carried out whenever the wavelength is changed.

The complimentary color method of selecting wavelength may not be applicable in all situations, perhaps because the solution has no distinct colour, or the solution is of a complex nature and the absorbing species of interest is not the predominant colour. In these circumstances it will be necessary to scan across the spectrum to determine points of maximum absorbance.
Situations also exist where solutions will absorb at more than one wavelength. If this situation is encountered it is usually best to select the wavelength which gives maximum absorbance.

It is always good practice to verify linearity (i.e; concentration vs reading) of the methodology at the selected wavelength. Where more than one absorbing wavelength is available, it is probable that one will offer better linearity characteristics than others.

To perform measurements the following procedures should be carried out:

Transmission Mode

This mode is selected by moving the cursor to the %T indicator on the menu bar using the LEFT or RIGHT arrow keys (refer diagram p.4). The primary display will show the transmittance, with %T units. The wavelength can be adjusted using the UP and DOWN arrow keys. A calibration routine is initiated by pressing the CAL key. The routine performs a zero% transmission calibration followed by a 100% transmission calibration. A blank (clear) solution should be used for this calibration procedure. (An internal shutter is automatically activated to perform the zero% setting and this part of the routine is therefore independent of the solution in the light path).

The following error codes are possible after a calibration:

Err 1 Dark cal error. This error occurs when the instrument closes the shutter to block light entering the sample chamber. If the detector output does not fall to a level normally associated with a dark cal then this error is indicated. The most likely cause is that the sample chamber lid is not closed.

Err 2 Light cal error. This error indicates that there is insufficient light to calibrate to 100%. The most likely cause is that light at the selected wavelength is being absorbed by a sample in the sample chamber. This error can also be caused if the lamp has failed.

A calibration resets the sample number to unity on any printed results.

Absorbance Mode

This mode is selected by moving the cursor to the ABS mode using the LEFT or RIGHT arrow keys (refer diagram on p.4). The primary display will show the absorbance, with ABS units. The wavelength can be adjusted using the UP and DOWN arrow keys. A calibration routine is initiated by pressing the CAL key.The routine performs a zero% transmission calibration followed by a 0.000 Absorbance calibration. A blank (clear) solution should be used for this calibration procedure. (An internal shutter is automatically activated to perform the zero% setting and this part of the routine is therefore independent of the solution in the light path). The instrument will display overrange (1. ABS) absorbance during the dark calibration. The possible error conditions are the same as for the transmission mode.

Concentration Mode

This mode is selected by moving the cursor to the CONC menu option using the LEFT or RIGHT arrow keys. The primary display will show the concentration, with ppm, mgl^{-1}, gl^{-1}, M, % or blank units. The wavelength can be adjusted using the UP and DOWN arrow keys.

Pressing the CAL key places the instrument in a concentration cal mode (indicated by the cal annunciator) which allows the UP and DOWN arrow keys to be used to change the displayed concentration to the required value (the wavelength adjust annunciator is extinguished, and the primary adjust annunciator is illuminated). Pressing the CAL or RETURN key, with the required calibration standard in the sample chamber, calibrates the concentration to the set value by calculating a multiplication factor for the current absorbance. If the factor calculated is out of range, then the instrument will display Err 3 for 2 seconds after the calibration.

The factor can be displayed on the secondary display by moving the cursor beneath the F AC-TOR menu option. With the factor displayed, the UP and DOWN arrow keys allow the factor to be set directly. Pressing the RETURN or CAL key returns to concentration plus wavelength mode.

The concentration units can be set by selecting the UNITS menu option and then scrolled through by using the UP and DOWN arrow keys (the wavelength adjust annunciator is extin-guished, and the adjust annunciator is illuminated, both primary and secondary display will show ---). Pressing the RETURN or CAL key returns to concentration plus wavelength mode.

3.3 GOOD PRACTICE GUIDELINES

1. For optimum performance all spectrophotometers should be sited in a clean, dry, dust free atmosphere. When in use ambient temperature and light levels should remain as constant as possible.

2. Adherence to Standard Operating Procedures (SOP) and Good Laboratory Practice (GLP) should be monitored with regular calibration checks and a suitable Quality Control (QC) programme.

3. The sample chamber lid must be fully closed during measurement and before any readings are recorded or printed.

4. The correct selection of sample containers is imperative for accurate and reproducible results:

   a) Plastic disposable cuvettes should be used ONCE only.

   b) Glass cuvettes should be thoroughly cleaned after use. Discard when scratches become evident in optical surfaces.

   c) Care should be taken when selecting semi-micro or micro cuvettes. The cuvette window on the inner chamber (the area filled with sample) must be wider than the aperture in the sample holder or light will reach the detector without passing through the sample. In this case, semi-micro or micro cuvettes with self-screening black surrounds must be used or, alternative holders for these cuvettes fitted.

   d) Glass test tubes and other sample tubes should be used with care. Where possible, matched tubes should be used and any index mark set to the correct position before measurements are made.

   e) Ensure any sample containers used are compatible with the consituents of both the samples and standards they are to hold. Plastic cuvettes are not compatible with organic solvents.

   f) All sample containers must be handled with care; by the top and non-optical surfaces only. Any finger marks evident must be removed by a suitable cleaning process.

   g) Flow-through cuvettes must be selected with care and consideration for the sample type, sample volume, pumping system, rinse, sample and waste handling to be used.

5. Samples and standards should not be stored in open cuvettes or sample containers as evaporation will change the value and lead to staining of the walls which may be irreversible. If stored in stoppered and sealed cuvettes, they should be filled with little or no air space and the values regularly checked against a reference standard or quality control material.

6. Cold samples should be allowed to equilibrate to ambient temperature before measurement (unless a suitable temperature controlled sample holder is in use). Temperature change during measurement may cause air bubbles to form on the walls of the sample holder. This is a common cause of drift during sample measurement.

7. In the preparation of samples and standards high grade borosilicate glass and AR grade chemicals and reagents must be used. Good quality deionised water or other suitable solvent must be used for dissolving or diluting samples, chemicals and reagents.

8. All measurements require calibration to a blank, for maximum accuracy this should be prepared with care using the same deionised water or solvent used for dissolving or diluting the sample. Where reagents are added to the sample to produce a colour proportional to its concentration a 'sample based' blank should be used. In this case the blank should consist of the sample plus any reagents or chemicals to be used, ***except*** those that produce the colour to be measured.

9. Deviations from the Beer-Lambert Law may occur at high and low concentrations giving non-linear response during sample concentration measurements. For all new methods a linear range should be defined by the preparation of a calibration curve.

10. Cuvettes and sample holders must be filled to a minimum level which covers the light path.

SECTION 4

MAINTENANCE

4.1 GENERAL

The Vis 100 is designed to give optimum performance with minimum maintenance. It is only necessary to keep the external surfaces clean and free from dust. The sample area should always be kept clean and any accidental spillage should be wiped away immediately. To give added protection when not in use, the unit should be disconnected from the mains supply and covered with the optional dust cover (630 028). For longer term storage or re-shipment it is recommended that the unit be returned to the original packing case.

NOTE: The instrument Monochromator is a non-serviceable unit and no attempt should be made to repair this item. Failure to observe this recommendation will result in the loss of any Warranty Claim on this product. In the unlikely event of the monochromator requiring service or calibration, it is essential that the Manufacturer or your local Distributor be contacted immediately for advice.

4.2 LIGHT SOURCE REPLACEMENT

The only routine maintenance which may be required is the replacement of the light source if this fails. Failure should be suspected if the lamp failure indicator appears on the display. This can be confirmed by looking in the sample chamber. The Tungsten Halogen lamp is available from the Manufacturer or your local Distributor (refer Section 5.2, Spares).

WARNING: Disconnect the instrument from the mains supply prior to replacing the lamp. Ensure the lamp is cool prior to handling. Care should be taken when removing the lamp from the holder.

1. Access to the tungsten halogen lamp can be gained via the lamp access panel, located at the rear of the unit (refer Section 2.4).

2. Slacken off the thumbscrew from the lamp access panel located at the rear of the instrument.

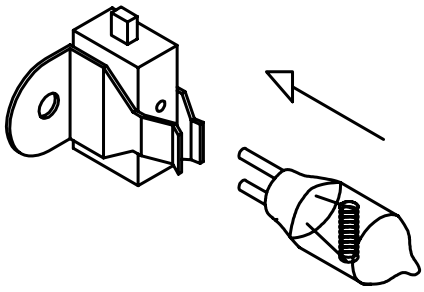
3. Remove the old lamp from the holder. The lamp is a plug-in fit and should be removed by gently easing it from the holder.

IMPORTANT: When fitting the replacement lamp it is essential that the glass envelope is not touched. Finger marks will damage the lamp. Should accidental damage with finger marks occur, the surface of the lamp may be cleaned using iso-propyl alcohol.

4. Carefully remove the replacement lamp from the packaging, ensuring the glass portion of the lamp is not touched.

5. Insert the lamp into the holder, as illustrated, ensuring that it is fully pushed home.

Fig. 4.2.1 Lamp Fitting



6. Close the lamp access panel and re-tighten the thumbscrew.

NOTE: It is essential that only the specified replacement lamp is used. Accuracy of optical alignment and performance cannot be guaranteed using alternative manufactured lamps.

SECTION 5

OPTIONAL ACCESSORIES

5.1 OPTIONAL ACCESSORIES

The following list of items are available as optional accessories for use with the Vis 100 except where specified:

630 005	Adjustable Cell Holder (10-100mm)
630 020	Test Tube Holder (12mm)
630 022	Test Tube Holder (16mm)
630 021	Test Tube Holder (25mm)
633 001	Heated cuvette system (cuvette holder and external control unit) supplied with interconnection cables, instruction manual, mains cables for EU, UK and USA. Universal voltage and frequency
632 001	External sipper pump supplied with inlet and outlet tubing, mains cable and instruction manual 230V/50Hz
632 031	External sipper pump supplied with inlet and outlet tubing, mains cable and instruction manual 110V/60Hz
630 028	Dust Cover
635 100	PC software on CD ROM (compatible with Windows™ 98 and above)
543 001	40 column printer
542 009	Interface cable kit
033 290	Storage case

5.2 SPARES

012 075	Tungsten Halogen Lamp
060 084	10 x 10mm plastic cuvettes (pack 100)
060 229	10 x 10mm plastic cuvettes (pack 500)
016 021	Replacement fuse 2A
016 025	Replacement fuse 1A
630 204	10 x 10mm MkII Cell Holder
060 287	Paper roll for printer (Qty 1)
060 288	Printer ribbon (Qty 1)

SECTION 6

INTERFACING

Serial Interface

The Vis 100 has a bi-directional RS232 interface set to:

1200 baud
7 data bits
odd parity
1 stop bit

The 25 way D connector allows a standard one-to-one interconnection lead to be used, as supplied with the 40 column printer/interface cable kit.
A printout is initiated by pressing the PRINT key. If the sample munber is unity, then the printout will include a header block. The sample number is incremented every time the PRINT key is pressed.

The following commands can also be sent to the instrument via the serial interface (using Windows HyperTerminal, for example).

ASCII **D** or **d**	Same as pressing the PRINT key
ASCII **T<CR>**	Outputs transmission and wavelength separated by an ASCII TAB character, regardless of the instrument operating mode. For example: 100.0 540
ASCII **A<CR>**	Outputs absorbance and wavelength separated by an ASCII TAB character, regardless of the instrument operating mode. For example: 0.001 540
ASCII **C<CR>**	Outputs concentration and wavelength separated by an ASCII TAB character, regardless of the instrument operating mode. For example: 123.4 540
ASCII **V<CR>**	Outputs a voltage proportional to the monochromatic light level passing through the sample and wavelength separated by an ASCII TAB character. For example: 1234.5 540
ASCII **Z<CR>**	Calibrates a zero absorbance if the dark shutter is open (SO<CR> command), or zero transmittance if the dark shutter is closed (SC<CR> command).
ASCII **SC<CR>**	Closes the dark shutter which blocks monochromatic light entering the sample chamber. This allows 0% transmittance to be calibrated.
ASCII **SO<CR>**	Opens the dark shutter which allows monochromatic light to enter the sample chamber. This allows 100% transmittance (zero absorbance) to be calibrated. The shutter must be open for normal measurements.
ASCII **Gnnn<CR>**	Commands the instrument to go to the wavelength **nnm**. For example: G540<CR> will set the wavelength to 540nm.

ASCII **Fxxxx.x<CR>** Sets the concentration factor to xxxx.x. For example: F1000<CR> will set the factor to 1000.

Note **<CR>** is an ASCII carriage return character.
The last three commands provide an output which can readily be incorporated into most spreadsheet software packages.

6.2 RS232 Output
The bi-directional RS232 interface is available on the rear panel 25 way D type connector. The connections are as follows:

TXD 2	- INPUT TO 6300/6320D
RXD 3	- OUTPUT FROM 6300/6320D
RTS 4	- LINKED TO CTS
CTS 5	- LINKED TO RTS
DSR 6	- OUTPUT FROM 6300/6320D
DCD 8	- OUTPUT FRM 6300/6320D
DTR 20	- INPUT TO 6300/6320D (must be active)
GND 7	

Suggested interconnections are detailed below:

6300/6320D			IBM PC XT (25 way “D”)
TXD 2	———	2	TXD (From PC)
RXD 3	———	3	RXD (To PC)
RTS 4	———	4	RTS (From PC)
CTS 5	———	5	CTS (To PC)
DSR 6	———	6	DSR (To PC)
DCD 8	———	8	DCD (To PC)
DTR 20	———	20	DTR (From PC)
GND 7	———	7	GND

6300/6320D			IBM PC XT (9 way “D”)
TXD 2	———	3	TXD (From PC)
RXD 3	———	2	RXD (To PC)
RTS 4	———	7	RTS (From PC)
CTS 5	———	8	CTS (To PC)
DSR 6	———	6	DSR (To PC)
DCD 8	———	1	DCD (To PC)
DTR 20	———	4	DTR (From PC)
GND 7	———	5	GND

NOTE: The Interface Cable Kit (Order Code: 542 009) can be used to implement the above interconnections.

Recorder Output
This is available via the 4mm rear panel sockets. The level is proportional to the displayed reading, depending on the measurement mode:

Transmission	1mV per 0.1%T
Absorbance	1mV per 0.001ABS
Concentration	1mV per concentration unit

EC Declaration of Conformity

The Buck 100 Spectrophotometer comply with the following European Standards:

EN 61326:1998	Electromagnetic compatibility - Electrical equipment for measurement, control and laboratory use
EN 61010-1:2001	Safety requirements for electrical equipment for measurement, control and laboratory use

Following the provision of:

EMC Directive - 89/336/EEC and Low Voltage Directive - 73/23/EEC